Visitor Impact Monitoring in the Coastal and Barrier Island Network

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Introduction

The preservation of the eastern coastal and barrier island protected areas continues to be an important priority for the National Park Service (NPS). These sandy beach coastal areas have a long history of visitor use, as they provide outstanding opportunities for recreation and nature appreciation. Combined with their proximity to the major population centers of the eastern United States, it is no surprise that visitation levels are high, representing an on-going management challenge. Moreover, these areas are unique and dynamic ecosystems, providing habitat to rare species.

This paper reports the findings of the first phase of a three-phase study to test candidate variables for future visitor impact monitoring programs at seven important coastal areas managed by the NPS (Table 1). This project is under the auspices of the larger biophysical monitoring effort of the Coastal and Barrier Island Network.

We initiated this project with the overall objectives of (1) determining which of the coastal NPS units require visitor impact monitoring programs; (2) developing a clear conceptual model of visitor threats to resources, related vital signs, and relevant indicators of resource condition; and (3) developing and testing accurate monitoring and sampling protocols of the indicators of the visitor-affected resources.

Specifically, this paper reports on the results of the initial phase of the study, consisting of site visits to each of the coastal areas and in-depth manager interviews. We had several objectives for this phase of the study. First was to determine which visitor-caused impacts were of concern to managers, and the general magnitude and location of these impacts. Second was to determine a suite of possible indicators to monitor visitor impacts in these environments. And last, we investigated the commonalities of the impact concerns so future protocols could be applied consistently across all network areas. Future phases of this study will develop and field-test specific monitoring protocols.

Table 1. Coastal and Barrier Island Network areas

NPS Unit	State
Assateague Island National Seashore	Maryland
Thomas Stone National Historic Site	Maryland
Cape Cod National Seashore	Massachusetts
Fire Island National Seashore	New York
Gateway National Recreation Area	New York
Sagamore Hill National Historic Site	New York
George Washington Birthplace National Monument	Virginia
Colonial National Historical Park	Virginia

Project Context

Considerable research has been conducted over the last 40 years on the consequences of recreational activities on natural resource conditions (Leung and Marion 2000) but, interestingly, relatively few studies have been conducted in sandy coastal areas (for a complete review, see the paper by Ingle et al. in these proceedings). Two recent monitoring efforts, one at Cape Cod National Seashore (Marion and Cahill 2003) and another at Boston Harbor Islands National Recreation Area (Leung 2002) have developed extensive visitor impact monitoring protocols, and these projects provide a basis for this effort.

Visitors to coastal parks are engaged in a wide array of recreation activities, most of which generate some level of impact. While visitor activity impacts may occur in many areas, impacts occurring within sensitive, natural/pristine, or protected zones are of most concern because of the ecological and social value of these areas. Monitoring visitor impacts in these areas is consistent with the objectives of the NPS Vital Signs Program (Fancy 2002) and would provide valuable input to the program, as the impacts may constitute a significant threat to ecological health.

In contrast, visitor activity impacts in developed or high-use areas are expected and can be controlled through intensive facility development and site hardening. In this case, monitoring visitor impacts is less beneficial. We also restricted our focus to impacts that occur in the terrestrial zone, within which indicators can be more effectively defined and measured. Some visitor-caused impacts, such as water pollution, were not included because they are more effectively monitored under other programs. Our approach parallels the efforts at Cape Cod National Seashore (Marion and Cahill 2003) and is supported by the findings of the visitor use management working group of the Coastal Monitoring Network (Marion et al. 2001).

For this initial phase of the study, we conducted extensive manager and field staff interviews and site visits to each of the NPS areas. Our objective was to become familiar with the visitor impact issues and concerns at each area, determine the approximate magnitude of these impacts, and begin the process of selecting field sites for the testing of field methodologies during subsequent phases of the project.

Impact Commonalities

Visitor impacts on coastal resources are a significant concern to managers in all areas visited, although the degree of concern and the potential for significant impact is highly area-dependent. For example, Gateway National Recreation Area, located within the limits of New York City, sees over 8 million visits per year, with many of these visitors engaged in activities that can potentially affect coastal resources. Conversely, at Sagamore Hill National Historic Site, the majority of visits occur in the museum facilities, with very little current activity on the trails and the small beach area. Given these differences in visitor activities, the nature and extent of monitoring activities will be highly area-specific, but all areas could benefit from some level of visitor impact monitoring.

For the purpose of this study, we have identified two categories of visitor impact concerns: (1) those applicable to the development of monitoring indicators in the context of this study (*Study Impact Concerns*), and (2) those beyond the scope of this study but raised by managers (*Additional Impact Concerns*).

Study Impact Concerns

Visitor impacts to vegetation and soils. All areas reported and we observed both current and potential impacts to beach and upland vegetation communities as a consequence of day and overnight use. Vegetation and soil disturbance is primarily caused by foot traffic, and, in Colonial National Historical Park, by mountain biking. Managers report that little if any information exists on the location and extent of these impacts and whether impacts are changing over time. In some cases these impacts are site-specific, in areas where use is concentrated (e.g., campsites, coastal access points for fishing), and off hardened or resistant substrates (i.e., boardwalks and sand, respective-

ly). In other cases these concerns are more widespread, such as the impacts of beach visitors to coastal sea beach amaranth, a federally listed plant species.

Wildlife impacts. Although some area-specific impacts on wildlife are occurring in the network, two impact concerns were common across the network. First was the impact of visitors on piping plovers (*Charandrius melodus*) and their habitat. Piping plovers occupy sand beaches and tidal flats and their numbers have been declining in recent years due to the extensive beach disturbance. Although significant management efforts are in place to limit visitor disturbance and preserve habitat during nesting season, it is not clear in all cases how much visitors are responding to interpretive information and complying with exclosures.

The second overall concern raised was the illegal harvesting of and interaction with wildlife. Assateague Island National Seashore and Gateway have concerns about the harvesting of fish, crabs, clams, and horseshoe crabs. Gateway experiences the illegal poaching of these animals and managers do not know the extent of the impacts or exactly how to prevent such activities. Managers at Assateague are concerned with the feeding and contact that visitors have with the wild horses.

Additional Impact Concerns

Off-road vehicle (ORV) use. Managers at Assateague, Gateway, and Fire Island National Seashore have raised concerns about the impacts of ORVs on coastal dune flora and fauna. At each of these areas, ORVs are limited to designated zones, specific trails, and/or travel corridors. In most cases total numbers of ORVs are limited by permit systems. Managers' observations would suggest that the nature and extent of ORV use has changed substantially at these areas over the last 10–20 years, with increases in numbers of visitors and shifts in visitor activity preferences. At Assateague, for example, previous ORV use was limited to a large extent to visitors engaged in sport fishing activities. As such, visitors would drive to an area above the tide line and park. Recently with the popularity of sport utility vehicles, more visitors are coming just to drive the beach, picnic, have campfires, swim, or to day-hike into the nearby dune and forest communities. Given the scope and extent of this project, we will not be developing monitoring indicators to address specific issues within the designated ORV zones, trails, or corridors. Monitoring protocols will address any impacts in natural areas adjacent to ORV zones where visitors may be traveling on foot or (illegally) by vehicle.

Proposed Indicators and Future Project Goals

"Vital signs" are key elements, processes, or features of the environment that can be measured and that indicate the condition of an ecosystem (Fancy 2002; Marion and Cahill 2003). In the forthcoming phases of this project, we will seek to address the study impact concerns as highlighted by managers and as outlined in the overall project plan by developing specific monitoring protocols for the measurement indicators identified below.

Vital signs, approaches, and measurement indicators appropriate to address the above concerns from a monitoring perspective fall into three categories: visitor use (Table 2), vegetation and soil degradation (Table 3), and disturbance of wildlife (Table 4). In order to appropriately address visitor impact concerns, initial information on the types, amounts, and distribution of impacts is essential. Technically, these elements are the actual agents of change, each with associated indicators (Table 2). The soil and vegetation and wildlife elements are vital signs of resource condition, again with associated indicators (Tables 3 and 4).

In the forthcoming phases of this project, we will examine the effectiveness and feasibility of the proposed indicators. More specifically, our immediate efforts are focused on the development of a conceptual visitor impact monitoring model for coastal ecosystems, additional monitoring methods development, follow-up site visits, gathering of GIS (geographic information systems) and visitor-use data from specific areas, and some preliminary field assessment. More long-term efforts will

Table 2. Agents of change, approaches, and indicators for changes in visitor use in natural zones

Agents of Change	Approach	Measurement Indicators
Types of recreation use	Managers' survey Direct field observation Entry point visitor survey	Use type
Amount of recreation use	Managers' survey Direct observation Trail/vehicle counters	Scale ratings of use frequency Observed number of visitors by activity type Number of hikers along selected trail segments
Distribution of recreation use	Managers' survey Direct observation Trail/vehicle counters	Location and extent of recreational use

Table 3. Vital signs, approaches, and indicators for extent of vegetation and soil degradation in natural zones

Vital Sign	Approach	Measurement Indicators
Vegetation loss	Direct on-site measurement at recreation sites and along trails	Relative cover loss (%) Changes in bare ground (%)
Vegetation compositional change	Direct on-site measurement at recreation sites and along trails	Individual species cover (%) Presence/absence of invasive plant species
Unintended trail formation	Direct on-site assessment and mapping	Location, extent, and mapping of visitor-created trails
Unintended site formation	Direct on-site assessment and mapping	Location, extent, and mapping of visitor-created sites
Shoreline disturbance	Direct on-site assessment and mapping in sensitive areas	Location, extent, and mapping of shoreline disturbance sites

Table 4. Vital signs, approaches, and indicators for disturbance of wildlife in natural zones

Vital Sign	Approach	Measurement Indicators
Disturbance type	Direct behavior observation	Type of visitor activities affecting wildlife (e.g., shorebirds)
Disturbance time	Direct behavior observation	Length of time of disturbance events
Attraction behavior	Direct behavior observation	Number of occurrences of wildlife feeding Number of occurrences of attraction behavior

lead to the completion of specific visitor impact monitoring protocols for all applicable areas in the Coastal Monitoring Network.

Conclusions

Managers throughout the eastern coastal and barrier island areas managed by NPS have raised concerns about visitor impacts on natural resources. These concerns can be categorized broadly as impacts on vegetation and soils, on wildlife, and of ORV use. Monitoring suggestions for these impacts consist of narrowing the scope of assessment to areas of the highest resource protection, where free-ranging, unregulated visitor use is occurring. Recreation ecology research indicates that this is of the most concern, as initial use can result in the majority of the impact. In this case, monitoring the agents of change, the visitor use and distribution, and specific indicators of soil, vegetation, and wildlife disturbance will address the majority of managers' concerns and will be applicable at the majority of NPS areas in the Coastal Network. Forthcoming field testing of specific protocols for the indicators will determine their appropriateness at and applicability to individual areas.

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